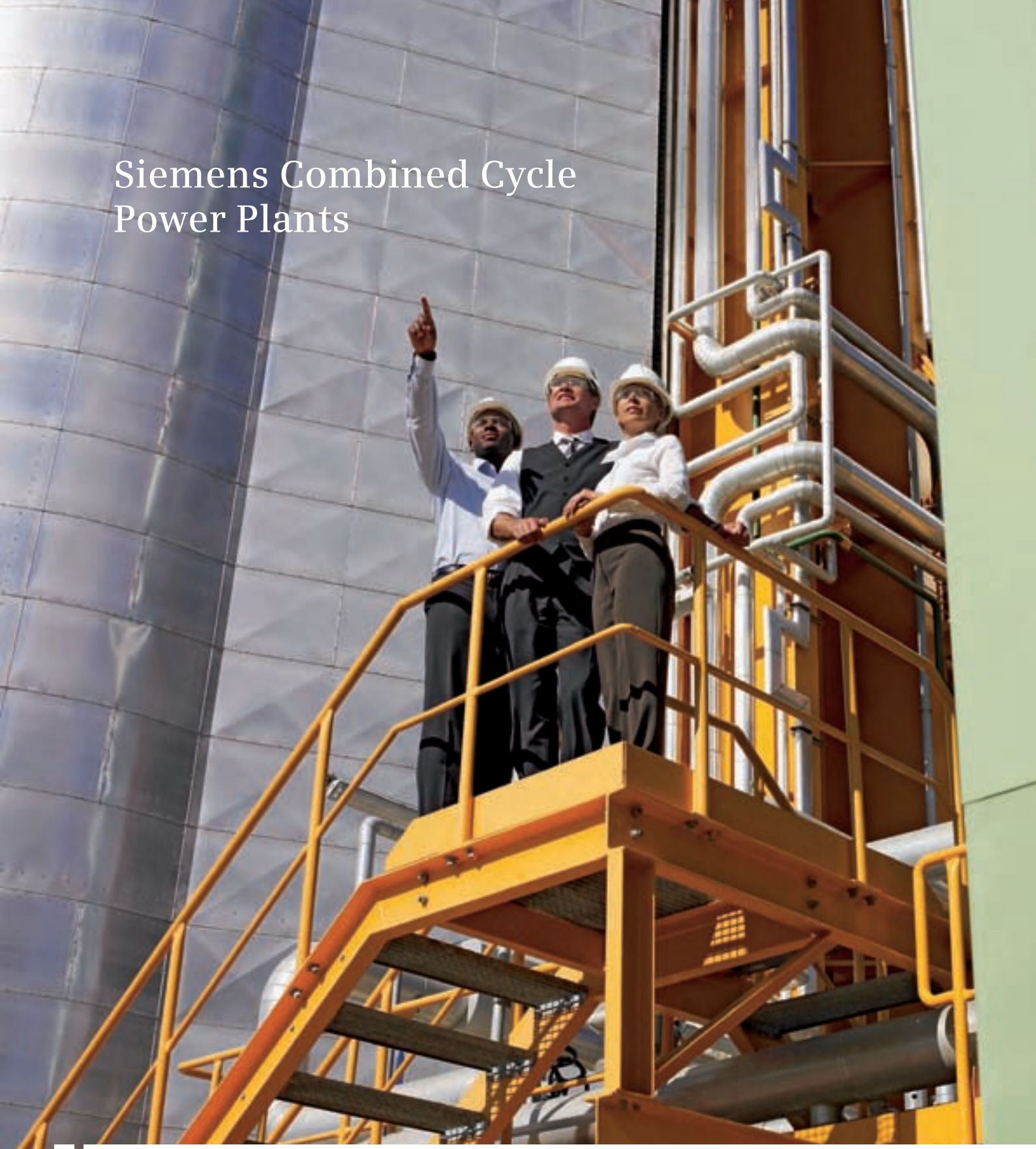
# Siemens Combined Cycle Power Plants



From Plans to Plants

Answers for energy.

SIEMENS

# Combined cycle strategy ...

## ... for changing markets

Changes in today's energy markets are presenting power producers worldwide with new challenges and opportunities.

In a competitive, market-driven economy, it is more important than ever to reduce power generation cost and to find solutions that provide a rapid return on investment without sacrificing long-term reliability and flexibility.

Based on our extensive experience in building power plants, Siemens has developed innovative combined cycle reference power plants, known as Siemens Combined Cycle (SCC™) turnkey plants. Suited for applications from 100 MW to over 850 MW per unit, these plants help you to meet the challenges of a dynamic market and are designed to optimize planning, implementation times and lower life-cycle costs.

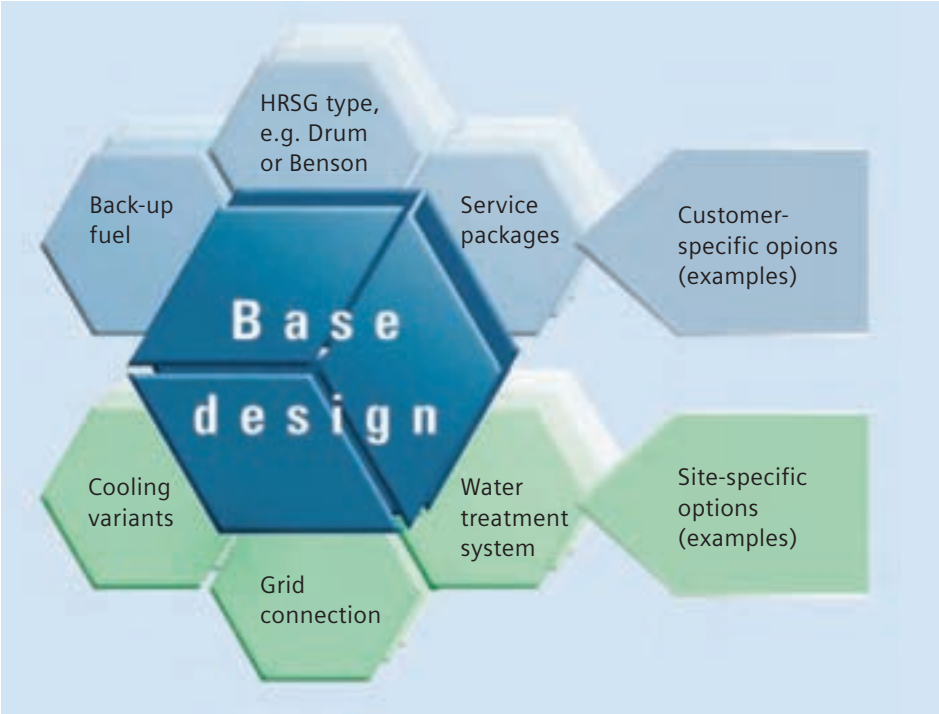
## ... for success

How do you design a combined cycle power plant for today's demanding market? For many, our reference power plant concept can provide the formula for success. This concept offers a proven base design with a set of standardized modules to meet the requirements of a specific country, region or site.

**The proven design for:**

- **High efficiency**
- **Superior reliability and availability**
- **Controlled capital costs**
- **Rapid implementation**
- **Environmental compatibility**
- **Operational flexibility**

It also shortens the planning phase and reduces the construction time. For example, all of our plants are designed with either axial or side-exhaust condensers, which do not require high-elevation foundations. As a result, installation work of main components can start earlier, and the plant can be finished faster. Plants have been completed as quickly as 20 to 24 months. It is an intelligent concept that cuts down construction times and increases customer benefits.




*The Siemens reference power plant concept is an innovative synthesis of standardization and flexibility. The combination of a pre-engineered design with modular add-ons provides the ideal basis for a successful project. This approach helps to keep life-cycle costs low while providing the flexibility to meet individual customer needs.*

# Our product portfolio

## Arrangements to suit all market needs

Our family of advanced combined cycle power plants was developed based on a common design philosophy. These reference power plants are available in single-shaft or in multi-shaft configurations in the capacity range between 100 MW and 850 MW for both 50 Hz and 60 Hz applications.

We also offer a complete line of combined cycle power plants with ratings below 100 MW from our industrial applications portfolio.

Whether single-shaft or multi-shaft, designing with state-of-the-art 3-D modeling results in rapid, high quality power plant implementation.

## Performance data*

| | Single-Shaft | | | Multi-Shaft | | | |
|---|---|---|---|---|---|---|---|
| | 50 Hz products | | | 50 Hz products | | | |
| Plant configuration | SCC5-3000E 1S | SCC5-4000F 1S | SCC5-8000H 1S | | SCC5-2000E 2x1 | SCC5-3000E 2x1 | SCC5-4000F 2x1 |
| Net power output (MW) | 290 | 423 | 530 | | 505 | 576 | 848 |
| Net efficiency (%) | 56.5 | 58.4 | > 60 | | 52.5 | 56.3 | 58.5 |
| Net heat rate (Btu/kWh) | 6,036 | 5,842 | < 5,687 | | 6,502 | 6,056 | 5,836 |
| Net heat rate (kJ/kWh) | 6,368 | 6,164 | < 6,000 | | 6,860 | 6,389 | 6,158 |
| No. of GT's | 1 | 1 | 1 | | 2 | 2 | 2 |
| | 60 Hz products | | | 60 Hz products | | | |
| Plant configuration | SCC6-1000F 1S** | SCC6-6000G 1S | | SCC6-5000F 1x1 Peaker | SCC6-5000F 1x1 | SCC6-5000F 2x1 | SCC6-6000G 2x1 |
| Net power output (MW) | 101 | 397 | | 275 | 293 | 590 | 794 |
| Net efficiency (%) | 52.6 | 58.8 | | 48.2 | 57.0 | 57.2 | 58.8 |
| Net heat rate (Btu/kWh) | 6,487 | 5,803 | | 7,079 | 5,990 | 5,960 | 5,803 |
| Net heat rate (kJ/kWh) | 6,844 | 6,123 | | 7,469 | 6,320 | 6,290 | 6,123 |
| No. of GT's | 1 | 1 | | 1 | 1 | 2 | 2 |

** Standard design, ISO ambient conditions; Status September 2007.* *** This product is also available for 50 Hz applications.*

# A scope of supply to meet your needs

## Modularity from turnkey to component package scope

Detailed knowledge of turbine and generator technology is a necessary prerequisite for turning potential projects into economically successful ones. For many years, Siemens has put this knowledge to work worldwide. Depending on your individual needs, we can provide consulting services, supply individual components, packages or a complete turnkey power plant.

Siemens offers a range of flexible scopes to fit your needs. For the multi-shaft power plant the modular design ranges from a complete Siemens Combined Cycle Turnkey (SCC™ Turnkey) plant to smaller scope packages or modules, including the Siemens Combined Cycle Power Island (SCC™ Power Island) and the Siemens Gas Turbine Package (SGT-PAC). For the single-shaft arrangement additionally the Siemens Combined Cycle Power Block (SCC™ Power Block) is available.

## SCC™ Turnkey – Highest customer value

Our range of combined cycle reference power plants combines the economical benefits of pre-engineered power plant designs with the flexibility afforded by modularization to customize for specific requirements.

## SCC™ Power Island – The core for an optimized power plant

With our in-house expertise in gas and steam turbine technology, Siemens has developed a SCC™ Power Island that increases the benefit of your investment. This package not only provides thermal cycle optimization and a performance wrap, but also system integration and optimized plant operation.

## SGT-PAC – The base for high efficiency

As the core of a multi-shaft power plant, our SGT-PAC provides high thermal performance with proven reliability.

*Project and site-specific performance data for this and other Siemens combined cycle products can be obtained through SIPEP, the Siemens Plant Performance Estimation Program. For access to SIPEP please contact your Siemens sales representative.*

*SGT-PAC: Gas turbine, generator, auxiliaries, and controls for supplied scope, inlet and exhaust systems.*

*SCC Power Island: SGT-PAC plus HRSG, steam turbine, condenser, major pumps, critical valves and controls for supplied scope.*

*SCC Turnkey: SCC Power Island plus buildings, structures, plant cooling, power control centers, electrical, switchyard, fuel delivery, piping, plant control system, balance of plant construction, erection and commissioning.*

# Designed for flexibility and low life-cycle costs

## The cost-effective concept for world-class efficiencies

Siemens combined cycle reference power plants offer options, allowing optimization of plant life-cycle costs and effective responses to environmental concerns. With our advanced-design gas and steam turbine generators and bottoming cycles, our power plants leverage the conversion of fuel energy at extremely high efficiencies. Thus they provide a significant improvement in operating economies by lowering fuel costs, reducing emissions and conserving resources.

Siemens has applied its knowledge and experience in engineering by equipping some of the most advanced and powerful combined cycle power plants in the world. Our technology is being continuously demonstrated in our worldwide operating fleet.

### Low emissions

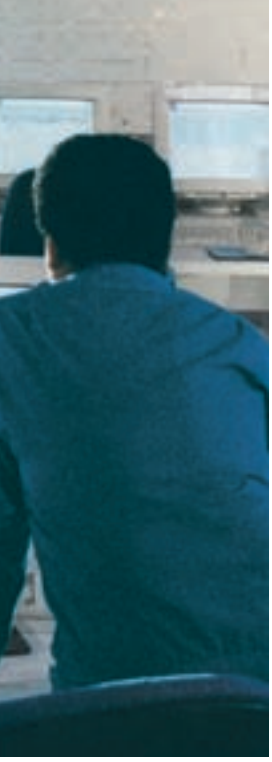
The combined cycle design incorporates highly efficient components and systems, which result in low NOx, CO and VOC emissions. The enhanced Dry Low NOx (DLN) and Ultra Low NOx (ULN) combustors provide flexible, stable, clean and economical operation.

Further provisions are available in the form of catalysts in the heat-recovery steam generators to reduce stack emissions to meet the most stringent requirements.

## Reliability, availability and maintainability

While efficiency is very important in achieving low life-cycle costs, high availability and reliability also are critical. Using proven, time-tested components and modules, we offer system redundancy options backed by RAM (Reliability, Availability and Maintenance) analyses to optimize overall life-cycle costs.

To further improve availability and provide a high level of automation, we utilize one of the world's leading instrumentation and control systems. This comprehensive approach allows us to integrate all details into a total power plant control concept.



## Operations and maintenance

### Operating flexibility

In response to the industry's growing need for improved operating flexibility from combined cycle plants, Siemens has developed a unique integration of proven technologies to significantly shorten plant start up times, which can greatly enhance the economic dispatch of the plant. In addition, this fast-start package reduces start-up emissions and fuel consumption, as well as demineralized water consumption. The fast-start technology package provides flexibility without compromising base-load efficiency.

So you will not have to concern yourself today with how your plant will be operated in the future. The benefits of the cycling program are realized both in the SCC™ Power Island module and turnkey scopes of supply.

### Maintenance

Our operations and maintenance philosophy is tailored to meet today's exacting availability expectations. A carefully planned and integrated maintenance strategy, along with extended major maintenance intervals, allows us to achieve high availability without compromising reliability. By leveraging our comprehensive expertise, we can establish a coordinated, scheduled maintenance program that allows us to plan in advance to ensure that the manpower, equipment and spare parts are exactly where they need to be when the maintenance is performed.

## A further unique feature – The modularized Power Control Center (PCC) concept

To take the idea of modularization and standardization to another level, we have pioneered the PCC concept in its reference power plant program. This concept provides multiple self-contained PCC modules located close to the major components and systems that they control.

Each Power Control Center consists of a shop-assembled module, prewired and pre-tested before shipment. These PCC modules can easily be interconnected on site. This saves precious time in construction and commissioning.

# At the heart of our combined cycle reference power plants

## Gas turbines

All our gas turbines share long-proven common technical features, including:

- Four-stage turbine for moderate stage loading
- Disk-type bolted rotor construction for rotor stability
- Dry Low NOx (DLN) or ultra low NOx combustors for reduced environmental impacts
- Dual-fuel capability (on-line transfer)
- Cold-end generator drive for increased efficiency
- Variable inlet guide vanes for improved part-load efficiency
- All blades removable with rotor in place for easy maintenance and shorter outages
- Unique design features for field serviceability across the fleet

## Steam turbines

Siemens experience with steam turbines dates back over 100 years. The combined cycle reference power plants incorporate two different Siemens Steam Turbine (SST™) configurations, the SST-3000 and SST-5000 series steam turbines, for efficient and reliable operation.

With almost 5,000 steam turbine units in operation, our fleet contributes nearly 540 GW of power generation capacity and represents 21% of the world's operating fleet.

The SST-3000 series steam turbine consists of a high pressure cylinder and a combined intermediate-pressure/low-pressure cylinder with an axial exhaust to the condenser.

The SST-5000 series uses a combined high-pressure and intermediate-pressure element and a two-flow low-pressure turbine for a compact and economical arrangement. The SST-5000 turbine is available with either a single-side or dual-side exhaust to the condenser.

## Exclusive steam turbine blade technology

To achieve the highest element efficiencies and operational reliability, our high-pressure, intermediate-pressure and low-pressure steam turbines incorporate the very latest development in blade technology. A full line of proven, robust blading modules allows us to meet virtually all site conditions or customer needs.

## Generators

Our advanced combined cycle reference power plants incorporate either air- or hydrogen-cooled generator designs, depending on the power requirements. By utilizing our unique modular generator design approach, we are able to shorten manufacturing lead time and provide proven technology with demonstrated efficiencies of over 99%.

To assure the quality of generator cores, we have developed a patented design where short circular stacks of laminations are pre-stressed and vacuum-pressure impregnated with epoxy to form bonded stator core packs. The use of core packs results in long-lasting core tightness, mechanical ruggedness and excellent heat transfer characteristics.

Our generator product line fully complies with applicable provisions of American and International Specification Standards including ANSI C50 and IEC 34.

# The convenience of single point responsibility

## Reliable project implementation

Generating reliable output in the shortest possible time after financial closing and Notice To Proceed (NTP) is key to realizing an early return on your investments. To support this, we make sure that on-time completion is the driving force behind our integrated project approach.

## Financial strength

To set the project clock in motion, Siemens financial strength and stability helps you secure the financial backing necessary to bring your project to successful completion. With sales of over € 87.3 billion in 2006, a historically strong and stable financial profile, more than 475,000 employees and about 300 manufacturing locations worldwide - Siemens is one of the most successful companies today and will continue to be in years to come.

## Proven world-class technology

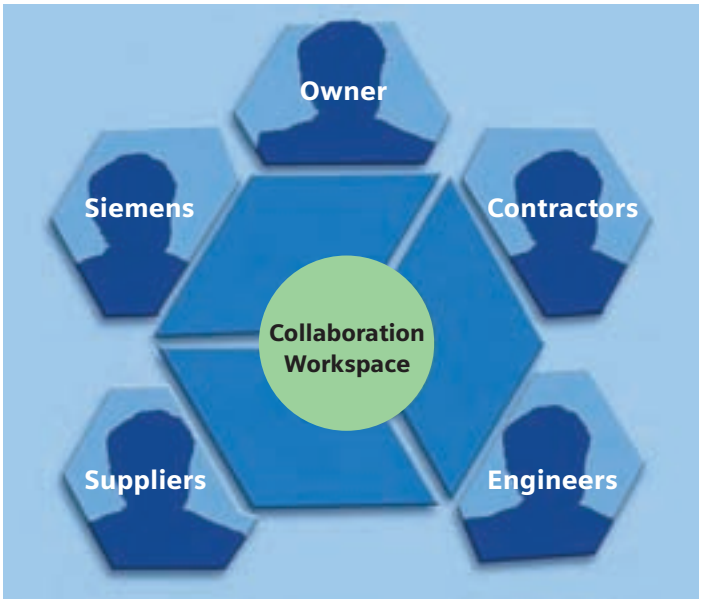
A well-funded reference power plant program is the foundation that enables us to provide cost-effective power plants with world-class performance and highly competitive project implementation schedules. With detailed information early on, we can support your initial conceptual and permitting phases. This helps you achieve financial closure sooner and can shave precious time off the front end of the project schedule.

The proven performance of our equipment and our in-house capability to design highly efficient, flexible, reliable and environmentally friendly power plants with subsequent operations and maintenance programs ensures that your asset generates maximum revenue throughout its life. Through the use of state-of-the-art 3-D modeling (including Intergraph PDS® and Smart Plant® Review software), we are able to develop detailed designs in the reference power plant program that are used for high-quality bid preparation and project execution. These programs provide accurate plant designs verified by constructability and maintainability reviews, thereby keeping your plant on a timely and orderly completion schedule.

## Integrated project approach

At the heart of a successful project is a competent, experienced project manager who has access to world-class project implementation tools that pull together all of the documentation and processes required to bring a plant online. Secure web-based systems connect us with our integrated, multi-disciplinary team of suppliers, engineering and construction partners, contractors and the plant owner to provide the basis for real-time collaboration on design, construction and operation including documentation and integrated scheduling.

All of the processes in this system are updated through a rigorous lessons-learned program derived from completed projects and have been validated using Six Sigma methodologies to ensure world-class quality. We work closely with our suppliers and partners to warrant this same level of quality. This results in clear objectives, common goals, a common construction-driven schedule and on-time completion of your project.




*Siemens provides secure online workspaces for collaboration on design, construction and operation to facilitate documentation and action tracking.*

## Experience and competence

Siemens has an extensive worldwide breadth of experience in building power plants on a turnkey basis. In the last five years, we have successfully completed more than 110 turnkey projects with a total output of over 30,000 MW. Overall, we have built more than 300 turnkey fossil power plants. From simple cycle to combined cycle, steam and industrial power plants, we have the expertise and competency to take charge of building your power plant wherever the project may be.

Our network of engineering expertise goes well beyond typical OEM component design capabilities. With almost 1,000 power plant design engineers and a global project organization of over 800 people, we possess the in-house competency to handle every project need.

Since the beginning of commercial power generation, Siemens has completed turnkey power plant projects for the demands of utilities worldwide. Our expertise covers all stages of a power plant project, ranging from engineering and design to financing, erection and commissioning, and finally, operation.

Furthermore, with service agreements in place for more than 40 power plants throughout the world with a total output of 15,000 MW, we know what it takes to design and build plants with operability and maintainability in mind. These requirements are fed back into the reference power plant development program to help elaborate power plant designs that provide low life-cycle costs.

## Driven by on-time completion

Armed with experience, resources and tools, we can offer competitive project schedules and guarantee that these schedules are met. With a dedicated program to closely monitor and analyze each and every project, product designs and processes are continually improved to world-class levels. This results in one overriding theme – our commitment to complete your project on-time to your total satisfaction.

# A global network of service and support

## For the entire life-cycle of your plant

At Siemens, we want to develop an ongoing partnership to ensure your project's long-term success. We are committed to serving our customers well after plant commissioning. As part of our commitment to being customer focused, we have established a powerful and responsive service network with more than 3,500 field engineers and technicians in regional service offices around the globe. So wherever you are, wherever your plant is located, we speak the language, we know the market and we are available to provide customer service and support 24 hours a day, 7 days a week. That is why we offer comprehensive service options including Corrective Maintenance, Preventive Maintenance, Performance Enhancement Programs, Service Agreements, as well as Training & Consulting.

With our extensive knowledge in supplying and servicing the power market, we offer an unparalleled level of comprehensive solutions that help our customers achieve competitiveness and profitability faster and easier. Furthermore, our global diversity and financial strength means that we will be there when and where you need us.

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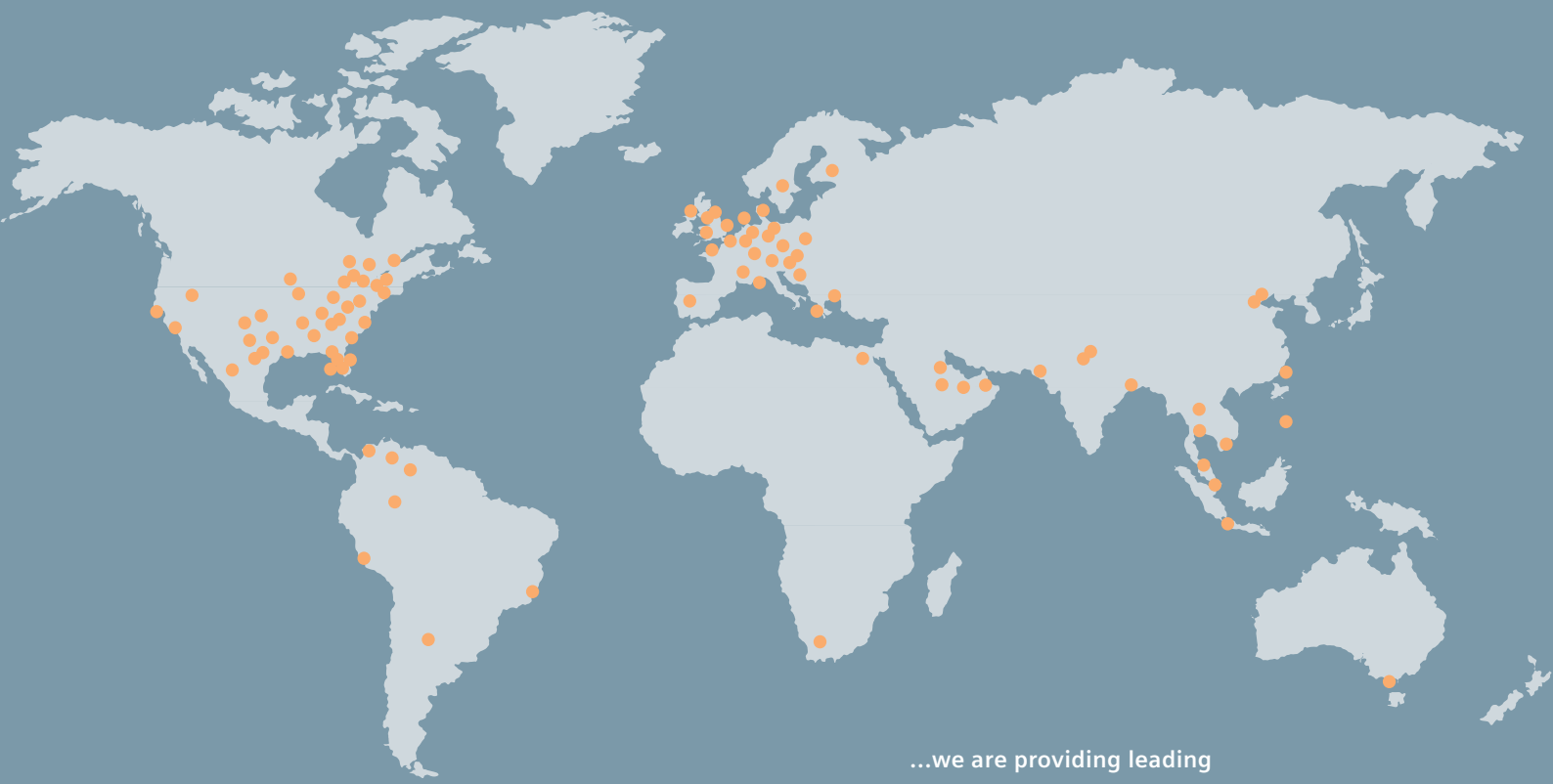

...we are providing leading technology for your combined cycle application.

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